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Controlling Late Blight (*Phytophtora infestans*) of Tomato Using Silver Nitrate and *Azadirachta indica* (Plant Extract)

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Abstract
Tomato is an important vegetable crop that is grown and consumed globally, there are various diseases attached to this crop, *Azadirachta indica* and Silver Nitrate have also been known to control the effect of many fungal and bacterial infections on agricultural plots, the objective of the study is to determine the effect of Silver Nitrate and the extract of *Azadirachta indica* on growth indices of tomato, disease incidence and severity of late blight of tomato as well as the yield of tomato on the field. Two tomato varieties chosen were ROMAN VF and 82 B, Tomato seedlings were raised on sterilized soil for four weeks in the screen house, and a young tomato plant was transplanted to the field where there is an epidemic of Late blight. Routine practices such as weeding and watering were carried out on the young tomato plants. Plant extract *Azadirachta indica* 25% was prepared as treatment 1 and 0.1M Silver Nitrate as Treatment 2. The prepared treatments were applied to the plant every week. The data were taken for plant height, number of leaves per plant, and incidence and severity of late blight on tomato plants. Data collected were subjected to analysis of variance (ANOVA) and significantly different means separation was done by using the Least Significant Difference at $p<0.05$ (LSD). The weight of Tomato fruit was 381.76g on Silver Nitrate while the lowest number was recorded on control to be 64.77 on the Roman VF variety of tomato while on 82 B variety of tomato, the highest value recorded for the weight of fruit was on Silver Nitrate as 414.80g while the lowest was recorded on control as 117.38g. Plant extract and Silver Nitrate aid in promoting plant height and formation of new leaves but late blight incidence and severity are better controlled by the application of plant extracts rather than Silver Nitrate for the tomato varieties used, Plant extract is better applied to control incidence and severity of leaf blight in Tomato, and Silver Nitrate gave highest number of leaves and quality yield.
Keywords: Tomato, Late blight, Silver Nitrate and Azadirachta indica

Introduction

Tomato (*Solanum lycopersicum L*) is an important vegetable crop grown across the world and Tomato and pepper (Capsicum species) are two of the most important vegetable crops cultivated in Africa and worldwide (FAOSTAT, 2020). Tomato ranked fourth among all crop species (after Rice, Wheat, and Soybeans) and it is the first among all vegetable crops (FAOSTAT, 2011). It is a good source of livelihood for farmers because harvesting starts immediately 11 weeks after planting and continues for an additional 15- 20 weeks if managed well. Tomato is generally consumed greatly globally and it is known as a source of vitamins and pro-vitamins (vitamin C, pro-vitamin A, β carotene, folate), minerals such as potassium, and secondary metabolites such as lycopene, flavonoids, phytosterols and polyphenols (Beecher19-98*)*. Tomato contains 95% water content and the remaining 5% consists mainly of carbohydrates and fiber. The nutritive content in (a 100-gram) raw tomato is Calories: 18, Water: 95%, Protein: 0.9 grams, Carbohydrates: 3.9 grams, Sugar: 2.6 grams, Fiber: 1.2 grams, Fat: 0.2 grams. There are various methods used to prevent Late blight of tomatoes this includes the use of chemical practices which involve a mixture of fungicides designed to slow the disease activities. Metalaxyl fungicides, a class of systemic fungicides, have been widely employed to control LB; they inhibit ribosomal RNA (rRNA) polymerases in fungi by reducing the incorporation of uridine (Gisi *et al*., 2011). The plant extract has been very useful in many aspects of life, they are natural substances derived from plants for different industrial purposes, for example as a food seasoning and natural medicine (Isman 2000), and also for pest management in

agriculture (Mansingh 2004). In most cases, it would appear that natural products derived from plants are safer than fungicides because they have low acute toxicity and because they are readily biodegradable into nontoxic products (Tripathi and Dubey 2004). Various diseases affect the production of tomatoes globally; this includes tomato late blight and fusarium wilt. Late blight (LB) has been identified as a major disease of tomato and potato; it is one of the most devastating plant diseases. An untreated tomato field can suffer yield losses reaching up to 100% because of LB infection (Nowicki *et al.* 2012). *Azadirachta indica* (A. Juss) is also called the neem tree, it is a tropical tree that originated from the Indian subcontinent (Noorul-Aneesa, 2016). Neem has been known for its wide array of beneficial properties, which include those in agriculture for pest control and also in traditional medicine for many human diseases. *A. indica* has been used as a non-toxic infection-control agent for treating crops in farming (Govindachari, 1992). Indeed, one of the most abundant compounds found within the neem plant, Azadirachtin, is an increasingly common biopesticide (Chaudhary *et al*., 2017; Pasquoto-Stigliani *et al*., 2017; Kilani-Morakchi *et al*., 2021). It has been discovered that every part of *A. indica* (e.g., the stem, bark, roots, leaves, gum, seeds, fruits, flowers, etc.) is used as household remedies for human illnesses. Neem twigs are used as chewing sticks for dental hygiene (Brahmachari, 2004; Gupta *et al*., 2017). Guleria and Kumar, (2006) showed that *Azadirachta indica* leaf extract induces resistance in sesame against *Alternaria* leaf spot disease. The objective of the research is to compare the effect of Silver Nitrate and extract of *Azadiracha indica* on growth indices of two susceptible tomato varieties, to determine the disease incidence and severity of late blight of tomato varieties and the yield of tomatoes.

Materials and Methodology

Study Area

The experiment was carried out at Tomato Research Field, Federal University of Agriculture, Abeokuta, Ogun State. The University is located along (3º23¹E and 7º20¹N). The vegetation of the area lies between the tropical rainforest and savannah regions, it has a tropical climate characterized by annual rainfall of about 1037mm, minimum and maximum temperature ranging between 20.66°C and 35.48°C.

Sample Planting

Tomato seedlings were raised on sterilized soil in nursery trays for four weeks in the screen house, after the fourth week, the young tomato plant was then transplanted onto the already-made bed in the field with routine practices such as weeding and watering. The experiment was laid out in a Randomized Complete Block Design with the two varieties. There are two treatments used in the experiment with three replicates, Treatment1 is the *Azadirachta indica* extracts 25% w/v and Treatment 2 is 0.1M Silver Nitrate ($AgNO_3$)

Preparation of Plant Extracts and 0.1M Silver Nitrate

Fresh young leaves of *Azadirachta indica* were collected and air dried for a few days, the leaves materials were ground into fine powdery particles. Twenty-five grams of the plant extracts were soaked in 100ml of distilled water for 24 hours (Wang *et al*. 2004), and the plant extracts were filtered and ready for use. Freshly prepared 0.1M of AgNO3 was done by dissolving 16.99g in 1L sterile distilled water. Plant extract and 0.1M Silver Nitrate were sprayed on the leaves of the plants two weeks after transplanting, and the application of the treatments continued every week till the commencement of harvesting.

Data Analysis

The data were taken from the leaves and stems in the form of plant height, number of leaves, number of fruits per plant, number of flowers per plant, and incidence and severity of late blight on tomato plants. Data collected were subjected to Analysis of Variance (ANOVA) and significantly different means separation was done by using the least significant difference at $p<0.05$ (LSD)

Results and Discussion

Growth measurement using Azadirachta indica and Silver Nitrate

The plant extract of *Azadirachta indica* and Silver Nitrate were used in the experiment with water as a negative control. The result shows that there were significant differences among all treatments in terms of plant height and number of leaves on the two varieties of tomato used. The first variety Roma VF shows that treatment with Silver Nitrate had the highest value on plant height and number of leaves although the period of taken measurement while the lowest plant height was on negative control Table:1, the second variety 82B shows treatment with Silver Nitrate had initial highest value on plant height at (4 WAT) but *Azadirachta indica* had the highest value on plant height at 6 and 8 WAT, treatment with Silver Nitrate has the highest number of leaves with 82B, while negative control had the least value Table 1.

Disease assessment

Roman VF shows that there were significant differences in the two treatments used during the incidence and severity of the disease, the highest value for disease incidence was recorded on Roman VF without treatment and the two treatments had the same measurement at the 6 and 8 WAT. The second variety 82B, treatment with Silver Nitrate had the lowest value of disease incidence compared to the plant extracts Table: 2. Disease severity shows that treatment with Plant extract had a lesser value compared with Silver Nitrate and again 82B still shows better performance compare with Roma VF Table 2.

Yield of tomato

There is a significant difference between the two varieties of tomato used, the highest value for weight of fruit was recorded as 381.76 on Silver Nitrate while the lowest number was recorded on control to be 64.77 on the Roman VF variety of Tomato. On 82B variety of Tomato, the highest value recorded for the weight of fruit was on Silver Nitrate as 414.80g while the lowest was recorded on control as 117.38g Tomato late blight

disease (P. infestans) has become one of the most important constraints for the successful cultivation of tomatoes. In recent years, the frequency and severity of late blight epidemics in tomato crops have increased in tomato-growing countries. Most commercial tomato cultivars are found to be susceptible to late blight. As a result, growers have been intensively using various chemical fungicides to control the disease. Today, it is environmentally, economically and scientifically unacceptable to rely primarily on fungicides for disease control. To minimize the use of fungicides against late blight disease, attempts are being made to develop integrated approaches to disease management. This study has shown that bio-pesticides extracted from *Azadirachta indica* could be used instead of chemical fungicides, Silver Nitrate. Bio-pesticides used generated 300% of the yield obtained from the control field while Chemical fungicides produced a 400% increase in the yield compared with the negative field. The use of bio-pesticide proved that it equally promotes leaf formation and plant growth compared with Silver Nitrate. Although the bio-pesticide was less effective in terms of yield compared with chemical fungicides they were found potential to provide some control of the pathogen. Farag-Hanaa *et al*. (2011) revealed that the application of *A. Indiana* extract and willow aqueous extracts on fusarium significantly reduce the level of lipid peroxidation and induce high activities of antioxidant defensive enzymes after 3 and 7 days of infection. It was also concluded that *A. Indiana* extracts reduced the disease incidence of fusarium wilt in tomato seedlings by increasing the activities of antioxidant defensive enzymes and decreasing the level of lipid peroxidation. Amadioha, (2000) observed that A. Indiana extracts were able to control Rice blasts in Rice plantations also Schneider and Ultrich, (1994) discovered that the plant extract was able to induce host plants' defence response resulting in a reduction of fusarium wilt development. The significant reduction of fusarium wilt disease in tomato plants treated with A. Indiana extract could be due to the presence of gedunin i.e. tetranortriterpenoid which possesses antifungal properties Sadre *et al*. (1983) or due to the presence of Azadirachtin (tetranortriterpenoid). Paul and Sharma (2002) Showed that *Azadirachta indica* leaf extract induced resistance in barley against leaf stripe disease. Singh and Prithiviraj (1997) revealed that the extract obtained from *Azadirachta indica* induced resistance in pea (*Pisum sativum*) against *Erysiphe pisi.*

Conclusion

The research work revealed that Silver Nitrate and *Azadirachta indica* had significantly reduced the effect of incidence and severity of disease on the two varieties of tomatoes used. *Azadirachta indica* controls the incidence and severity of the disease better than Silver Nitrate, but Silver Nitrate had the highest yield obtained from the two varieties of Tomato used. It is observed that the application of Silver Nitrate and *Azadirachta indica* extract is very good practice in the management of late blight of tomatoes on the field.

The study has shown that Azadiracha indicia control the disease attack and Silver Nitrate boosts yield this work is therefore recommending Silver Nitrate for the management of leaf blight disease of tomatoes because of the higher yield recorded with the use of Silver Nitrate.

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Table 1: Effect of Silver Nitrate and *Azadirachta indica* on the growth of tomato

Varieties	Treatment	PH WK4	PH WK6	PH WK8	NL WK4	NL WK6	NL WK8
ROMA VF	Control	20.37a	20.80c	20.33b	7.00a	7.67c	9.67b
	Azadiractha indica	28.50a	31.80ab	34.87a	8.67a	14.33a	18.00a
	Silver Nitrate	29.20a	33.30a	36.30a	9.00a	15.67a	18.67a
82B	Control	24.80a	25.10bc	25.33b	8.00a	10.33bc	12.33b
	Azadiractha indica	26.63a	33.90a	36.90a	8.67a	12.67ab	16.67a
	Silver Nitrate	27.07a	30.83ab	32.93a	8.67a	14.33a	17.00a

Note: PH = Plant Height, NL= Number of Leaves
Mean in the same column with different alphabets are significantly different (P>0.05) using least significant difference (LSD) as mean separation

Table: 2 shows the effect of Silver Nitrate and A*zadirachta indica* on Disease Assessment

Varieties	Treatment	DIWK6	DIWK8	SVWK6	SVWK8
ROMA VF	Control	50.00a	53.33a	4.00a	5.00a
	Azadiractha indica	30.00b	30.00b	1.67b	2.67c
	Silver Nitrate	30.00b	30.00b	2.00b	3.33bc
82B	Control	50.00a	60.00a	4.00a	4.67ab
	Azadiractha indica	30.00b	30.00b	1.33b	2.67c
	Silver nitrate	23.33b	23.33b	1.33b	2.67c

Note: DI= Disease incidence, SV= Severity
Mean in the same column with different alphabets are significantly different (P>0.05) using least significant difference (LSD) as mean separation

Table 3: Effect of Silver Nitrate and *Azadirachta indica* on the yield of Tomato

Varieties	Treatment	FRUIT W (G/HA)
ROMA VF	Control	64.77b
	Azadiractha indica	207.12ab
	Silver Nitrate	381.76a
82B	Control	117.38b
	Azadiractha indica	360.62a
	Silver Nitrate	414.80a

Mean in the same column with different alphabets are significantly different (P>0.05) using least significant difference (LSD) as mean separation